IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1, before the first line, insert –This is a continuation of application number 09/907,939 filed 19 July 2001, which is a continuation of application number 09/409,872 filed 1 October 1999, patent number 6,266,169, which is a continuation of application number 09/244,856 filed 5 February 1999, patent number 6,018,405, which is a continuation of application number 08/746,027 filed 5 November 1996, patent number 5,875,046, which is a continuation of application number 08/705,366 filed 29 August 1996, patent number 5,812,289, which is a continuation of 08/044,425 filed 7 April 1993, patent number 5,555,477, which is a continuation-in-part of application number 08/023,546 filed 26 February 1993, patent number 5,500,756.

Page 1, line 6 to page 5, line 14: Replace with the following amended paragraphs:

The present invention relates to an optical transmission method and system for carrying data transmission with the use of optical fiber. More particularly, it concerns an optical transmission method and system preferable in high-speed data transmission [[to]] over a long distance.

Description of the [[Prior]] Related Art

Prior [[arts]] art related to the optical transmission system includes, for example, the technique disclosed in the Japanese Patent Application Laid-Open 3-296334.

However, it is ~~demanded~~ required to accomplish an optical transmission system operating at further higher speeds since development of the modern information society has increased long-distance communication traffic in recent years. Also, it is desired that the optical transmission system can transmit data ~~to further~~ even longer distances without repeaters ~~in view of~~ to increase reliability and decrease cost of the system.

Furthermore, the number of fields to which an optical transmission system is applied has been increased with the recent development of the information society. For [[the]] this reason, it is needed to ~~accomplish the~~ achieve an optical transmission system having a variety of functions and the ~~capacities~~ capacity to satisfy various specific requirements.

SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the present invention to provide an optical transmission system constructing method capable of easily constructing an optical transmission method and system depending on required functions and capacities.

Briefly, the foregoing object is accomplished in accordance with aspects of the present invention by an optical transmission system. The optical transmission system is characterized [[in]] by constructing a line terminal having multiplexing means for multiplexing signals and demultiplexing means for demultiplexing the multiplexed signal [[so that]] to serve as a transmitter[[,]]. [[the]] The lineterminal is selectively capable of implementing either of two types of converters a first combination of an electric-to-optic converter circuit for converting the electric signal multiplexed by the multiplexing means to a transmission light with an optical fiber amplifier for amplifying the transmitting light before feeding into an optical transmission medium; or an electric-to-optic converting means having a semiconductor optical amplifier for converting the electric signal multiplexed by the multiplexing means to a transmission light before feeding an optical transmission line. The optical transmission system also is characterized [[in]] by constructing the line terminal [[so that]] to serve as a receiver[[,]]. [[the]] The line terminal is selectively capable of implementing either a second combination of an optical fiber amplifier for amplifying a receiving light from an optical transmission medium with an optic-to-electric converter circuit for converting the amplified receiving light to an electric signal before feeding to the demultiplexing means or an optic-to-electric converting means for converting the received light from the optical transmission medium to electric signal before feeding to the demultiplexing means with an avalanche photodiode used as a light receiver.

Also, the optical transmission system is characterized [[in]] by constructing the optical transmission system for use as a ~~longdistance~~ long distance optical transmission system[,]. [[a]] A plurality of the line terminals having the first combination to serve as the transmitter and the second combination to serve as the receiver implemented therein; each are connected to the optical transmission medium through a single or a plurality of repeaters inserted in the optical transmission medium for multiplying the optical light signal on the optical transmission medium.

Further, the optical transmission system is characterized in constructing the optical transmission system for use as a ~~shortdistance~~ short distance optical transmission system[[,]]. [[the]] The plurality of the line terminals having the electric-to-optic converting means having

a semiconductor optical amplifier therein to serve as the transmitter and the optic-to-electric converting means having the avalanche photodiode used as the light receiver to serve as the receiver implemented therein, ~~each are~~ each are directly connected to the optical transmission line.

The optical transmission system constructing method of the present invention enables an easy construction of any of the long-distance [[an]] and short-distance optical transmission systems only by selecting desired types of [[the]] transmitters and receivers to be implemented to change the combinations of the units. This is because the line terminal is constructed [[so that]] to serve as the transmitter[[,]]. [[the]] The line terminal is selectively capable of implementing either the first combination of an electric-to-optic converter circuit for converting the electric signal multiplexed by the multiplexing means to the transmission light with an optical fiber amplifier for amplifying the transmitting light before feeding into an optical transmission medium or electric-to-optic converting means having the semiconductor optical amplifier for converting the electric signal multiplexed by the multiplexing means to the transmission light before feeding an optical transmission line, and [[that]] so as to serve as the receiver, the line terminal is selectively capable of implementing either the second combination of an optical fiber amplifier for amplifying the receiving light from an optical transmission medium with an optic-to-electric converter circuit for converting the amplified receiving light to electric signal before feeding to the demultiplexing means or an optic-to-electric converting means for converting the received light from the optical transmission medium to electric signal before feeding to the demultiplexing means with an avalanche photodiode used as light receiver.

The foregoing and other objects, advantages, manner of operation and novel features of the present invention will be understood from the following detailed description when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

~~In the accompanying drawings:~~

Fig. 1 is a block diagram for a functional construction of [[a]] an optical transmission system of an embodiment of the present invention.

Fig. 2 is an overall configuration for a network system related to the embodiment of Fig. 1.

Fig. 3 is a configuration for a network among [[a]] large-scale switching nodes

extracted from the network system of Fig. 2.

Fig. 4 is a configuration for a network among [[a]] small-scale switching nodes and among [[a]] small-scale switching nodes and the ~~large scale~~ large-scale switching node extracted from the network system.

Page 7, lines 3-5: Replace the descriptions of Figs. 12 and 13 with the following amended description:

Fig. 12 [[is]] shows parth group switching procedures at failure.

Fig. 13 [[is]] shows a typical sequence of switching requests.

Page 7, lines 19-20: Replace the description of Fig. 21 with the following amended description:

Fig. 21 is a block diagram for a board constructions of the 1R-REP.

Page 8, lines 16-18: Replace the description of Fig. 31 with the following amended description:

Fig. 31 is a block diagram for extracted parts serving [[to]] as the surveillance and control system for the LT-MUX.

Page 9, lines 7-9: Replace the description of Fig. 38 with the following amended description:

Fig. 38 [[is]] represents structures of [[a]] an optical preamplifier and optical booster amplifier forming a single 1R-REP system.

Page 9, lines 20-24: Replace the descriptions of Figs. 43 and 44 with the following amended descriptions:

Fig. 43 is a front view [[for]] of an implementation of the LT-MUX for constructing the ~~large scale~~ large-scale switching node.

Fig. 44 is a front view [[for]] of an implementation of the 3R-REP.

Page 10, line 1: After "DETAILED DESCRIPTION" delete 'OF THE INVENTION".

Page 10, line 11 to page 11, line 21: Replace these two paragraphs with the following amended paragraphs:

The optical transmission system, as shown in Fig. 1a, is an ~~ultralong~~ ultra-long

distance transmission system for making optical transmission between line terminals with multiplexers (hereinafter referred to as the LT-MUX 1) or between the LT-MUX 1 and a regenerator (hereinafter referred to as the 3R-REP3) with use of an optical amplifier repeater (hereinafter referred to as the 1R-REP 2). The system can send the data at 10 Gb/sec through an optical fibre 40 up to 320 km by the 1R-REP 2.

The LT-MUX 1 makes a multiplex and section-termination-process (12) of the data received by an intra-office interface 11 provided therein, and converts them to an optical signal (13). An optical booster amplifier 14 magnifies the optical signal before feeding it into an optical transmission medium. On the ~~contrary~~ other hand, the data received from the optical transmission medium is magnified by an optical ~~preamplifier~~ pre-amplifier 15 before being converted to an electrical signal (16). The signal then is demultiplexed and section-termination-processed (12) before being distributed to the intra-office interfaces 11. The 1R-REP 2 repeats the optical signal in a way that any of the optical fiber amplifiers 21 and 22 magnifies the optical signal received from the optical transmission medium before feeding it out. The 3R-REP 3 regenerates the data to repeat in a way that the data received from the optical transmission medium are magnified by an optical ~~preamplifier~~ pre-amplifier 35 before being converted to electrical signal (36). The electrical signal then is demultiplexed and section-termination-processed (32) and is multiplexed and section-termination-processed (32) again. It further is converted to optical signal (33) and magnified by an optical booster amplifier 34 before being fed into the optical transmission medium.

Page 12, line 5 to page 13, line 7: Replace these three paragraphs with the following amended paragraphs:

The intra-office interface 11 of the LT-MUX 1 can contain a series of STM-1 (150 Mb/sec) by 64 or a series of STM-4 (600 Mb/sec) by 16. (Note that the series of STM-4 (600 Mb/sec) by 1 can be compatible with the series of STM-1 by 4).

The optical transmission system can be configures in another way so that instead of the 1R-REP 2 shown in Fig. 1a, the LT-MUXes 1 are directly connected together or the LT-MUX 1 is directly connected with the 3R-REP 3. In this case, the transmission distance is up to 120 km without repeater.

Also, the optical transmission system can be configured in still another way, such as that shown in Fig. 1b[[,]]. [[the]] The 1R-REP 2, the optical booster amplifier 14, and the optical ~~preamplifier~~ pre-amplifier 15 are omitted, but LT-MUXes 1 having an opto-electric

converter [[2000]] <u>2010</u> and an electro-optic converter [[2010]] <u>2000</u> which are different in the characteristics from those of the LT-MUX 1 in Fig. 1a are directly connected together. In this case, the output level is around +6 dBm, and the transmission distance is up to 80 km without repeater.

The optical transmission system having the LT-MUX 1, the 3R-REP 3, the optical booster amplifier 14, and optical ~~preamplifier~~ <u>pre-amplifier</u> 15 is called the long-distance system ~~below~~ <u>hereunder</u>; and the optical transmission system having no optical booster amplifier 14 and optical ~~preamplifier~~ <u>pre-amplifier</u> 15 in the LT-MUX 1 and 3R-REP 3 is called the ~~short distance~~ <u>short-distance</u> system below <u>hereunder</u>.

<u>Page 13, line 18 to 17, line 6</u>: Replace the 10 paragraphs with the following amended paragraphs:

The large-scale switching nodes 110 in the network sytem related to the embodiment, as shown in the figure, are directly connected therebetween in a ladder-shaped structure with use of the 1R-REP 2 and the 3R-REP 3. The network system has routes diversed therein and the CCITT recommended VC-3/4 path protection switch in the meshed network, thereby increasing reliability of the network. The small-scale switching nodes 120 are ~~ringstructured~~ <u>ring-structured</u>, and the small-scale switching nodes 120 and the ~~large scale~~ <u>large-scale</u> switching nodes 110 are also ring-structured. This [[does]] not only provide<u>s</u> a multiplexing effect that allows efficient use of the large-capacity transmission medium, but also keeps two routes that can increase the reliability. In addition, a metropolitan area <u>130</u> has a ~~multiple~~ <u>multiplicity</u> of rings ~~that can~~ <u>for</u> ~~increase~~ <u>increasing</u> the reliability in ~~an area of~~ <u>a</u> relatively narrow, but large, ~~facial extending~~ traffic <u>area extending over a flat wide area</u>.

Fig. 3 is a configuration for a network among the large-scale switching nodes [[130]] <u>110</u> extracted from the network system.

The large-scale switching nodes [[130]] 110, as shown in the figure, are directly connected ~~thereamong~~ <u>there among</u> with use of the 1R-REPs 2 and the 3R-REPs 3 without switching through an intermediate node, thereby decreasing the line cost. A distance between the 1%R-REPs 2 is <u>designed</u> up to 80 km ~~in view of~~ <u>taking into account</u> the S/N ~~design~~ <u>ratio</u>, and the [[one]] <u>distance</u> between <u>one of</u> the ~~3RREPs 3~~ <u>3R-REPs 3 and the note</u> is <u>designed</u> up to 320 km in [[view]] consideration of the nonlinear distortion of the <u>optical</u> fiber.

Fig. 4 is a configuration for a network among the small-scale switching nodes 120 and among the small-scale switching nodes 120 and the ~~large scale~~ <u>large-scale</u> switching nodes

110 extracted from the network system.

If a distance between the small-scale switching nodes 120 is shorter than 120 km, as shown in the figure, no repeaters are used, [[but]] and instead direct connection is made between any two of the ~~smallscale~~ small-scale switching nodes 120. If the distance exceeds 120 km, the 1R-REP 2 is used to make the ~~long distance~~ long-distance system as mentioned previously. If the distance is shorter than 80 km, as will be described in detail later, the 10 Gb/sec transmitter is replaced by the one made up of a semiconductor optical amplifier and an APD (avalanche photodiode) to form a further economical ~~short distance~~ short-distance system (Fig. 1b).

Fig. 5 is a configuration for a network for the metropolitan area extracted from the network system.

The metropolitan area, as shown in the figure, has a plurality of adjoining rings formed [[of]] by the transmission media connecting the nodes in a meshed network, thereby accomplishing efficient multiplex operation and high reliability. It should be noted that there will be a greater number of the shorter node distances than 80 km. Then, as described above, the ~~short distance~~ short-distance system is made up of the semiconductor optical amplifier and the APD to form the network at low cost.

Fig. 6 [[is]] represents block diagrams for the functional construction of the node.

The ~~large scale~~ large-scale switching node 110, as shown in Fig. 6a, has two LT-MUXes 1 and a VC-3/4 cross-connection switch 111 for path switching and setting at the VC-3/4 level in the synchronous digital hierarchy (SDH). The two LT-MUXes 1 are connected by a high-speed interface which will be described later, but not any intra-office interface. The ~~large scale~~ large-scale switching node 110 also has the STM-1 interface and the STM-4 interface as the ~~intraoffice~~ intra-office interfaces. These interfaces can connect a line repeater terminal 5000 for transmission between [[a]] 600 Mb/sec or 2.4 Gb/sec offices, a cross-connection equipment 5100 for terminating the intra-office interface [[111]] 11, and an ATM cross-connection switch 5200. The ATM cross-connection switch 5200, if used, can accomplish lower cost and decrease cell delay as the 600 Mb/sec intra-office interface is used. Note that the ~~large scale~~ large-scale switching node 110 can be alternatively made up of the two ~~LTMUXes 1~~ LT-MUXes 1 and a cross-connect equipment 111.

The small sacle small-scale switching node 120 is the same as the ~~large scale~~ large-scale switching node 110 or as shown in Fig. [[1b]] 6b, has the LT-MUX 1 and [[an]] a VC-3/4 add-dropp multiplex (ADM) switch. The ~~small scale~~ small-scale switching node 120

also, like the ~~large scale~~ large-scale switching node 110, has the STM-1 interface and the STM-4 interface as the ~~intraoffice~~ intra-office interface, which can connect the line repeater terminal 5000 for transmission between [[a]] 600 Mb/sec or 2.4 Gb/sec offices, the cross-connection equipment 5100 for terminating the ~~intraoffice~~ intra-office interface [[111]] 11, and the ATM cross-connection switch 5200.

Page 18, line 1 to page 19, line 2: Replace the six paragraphs with the following amended paragraphs:

As shown in the table, the present embodiment defines the new [[VC3/4]] VC-3/4 path group to accomplish easy path switching [[at]] upon failure of any transmission medium.

Fig. 8 is a frame construction for an STM-64 which is an inter-office interface.

The overhead for the VC-3/4 path group, as shown in the figure, is the Z3 byte of the representing VC-3/4 POH forming the VC-3/4 path group.

The following describes the path switching with use of the path group at failure of any transmission medium.

The term "path group" as used herein denotes a set of parts within a ring of the VC-3/4 path such that a point of insertion into a virtual ring ~~is equal to each other~~ and a point of branch from the virtual ring [[is]] are equal to each other. The term "virtual ring" as used herein denotes a ring extracted from the network as a part which can virtually form a ring-like path. It should be noted that as shown in Fig. 9, the path group is positioned between section plane and path layer in view of the network layer structure.

The embodiment switches the path group when the path group is at failure. The path group is managed with use of the Z3 byte of the representing VC-3/4 path overhead within the path group. Fig. 10 is a bit allocation of the Z3 byte. The path group failure is detected by a path group alarm indication signal (PGAIS) defined in [[the]] Z3 byte.

Page 22, line 15 to page 24, line 14: Replace the five paragraphs with the following amended paragraphs:

Each of the LT-MUXes and the [[1R-REPs 2]] 1R-REPs 2,3 has a surveillance and control function 1001 and an OpS-IF 1002 for connection with an OpS (operation system) 1000. The surveillance and control are made under control of the OpS 1000 which governs the surveillance and control of the system.

The embodiment makes a wavelength multiplex of a surveillance and control signal

with a main signal on the STM-64 interface before transmitting the multiplexed signal to monitor and control the [[1R/3R-REPs 3]] 1R/3R-REPs 2,3 having no OpS IF 1002 remotely. That is, the OpS 1000 gives a direction signal to the equipment having the OpS IF 1002 to make the equipment superimpose the direction signal onto the surveillance and control signal, or makes the 1R/3R-REP having no OpS IF 1002 transfer an alarm detected or generated by the 1R/3R-REP to the equipment having the OpS IF 1002. Alternatively, it can be made that the 1R/3R-REP should have the OpS IF 1002 to allow the OpS 1000 to monitor and control the 1R/3R-REP directly.

In turn, the surveillance and control signal of 384 kb/sec is transferred by a light of the same 1.48 .mu.m wavelength as that of a pumping light source of the 1R-REP 2. The surveillance and control signal, as shown in FIG. 22, also has a 48 byte frame length for a 1 msec frame period, 24 bytes (192 kb/sec) of which are allocated to a DCC (data communication channel) for the remote control, 8 bytes (64 kb/sec) for an order wire, and 6 bytes (48 kb/sec) for the alarm transfer. The surveillance and control signal allows each of the [[1R/3R-REPs 2]] 1R/3R-REPs 2,3 to inform the state and alarm. That is, each of the 1R/3R-REPs can generate its own monitoring information and repeat the surveillance and control signal generated by the preceding 1R/3R-REP as well. The state monitoring is made at intervals of 1 sec so that an access collision cannot happen even if the number of the [[1R/3RREPs]] 1R/3R-REPs is around 100.

Also the surveillance and control signal has 1 byte allocated there to [[as]] the 1R-REP section that has a feature equivalent to that of the usual AIS. The 1R/3R-REP having detected a fatal failure, such as loss of the main signal, transfers its own ID to the succeeding repeater using the one byte. This 1R/3R-REP 2,3 repeats the one byte to the LT-MUX 1. This allows informing of the 1R/3R-REP section AIS at intervals of 1 msec. If it is used, the 3R-REP converts it to an S-AIS (section alarm indication signal).

The features of the surveillance and control system are charted in Tables 5 and 6. Surveillance and control items are charted in Table 7.

Page 29, lines 11-17: Replace the paragraph with the following amended paragraph:

(c) F1 byte process: If it detects a fatal failure, the 3R-REP writes its own ID into the F1 byte of the sending STM frame. Also, if it receives the surveillance and control signal indicating that the preceding ~~the 1R-REP~~ 3R-REP is at failure, the [[3RREP]] 3R-REP writes the ID in a predetermined byte into the F1 byte of the sending STM frame.

__**Page 30, line 13 to page 32, line 11**__: Replace the five paragraphs with the following amended paragraphs:

As shown in the figure, the embodiment includes a modulator integrated light source module 200 of 1552 nm wavelength having little chirping as a sending light source for the LT-MUX 1 and the [[3RREP 3]] <u>3R-REP 3</u>. To suppress an SBS (stimulated Brilloiun scattering) caused in the optical fiber, the embodiment uses the spectrum broading <u>so</u> that a signal of a low-frequency oscillator 201 is applied to a laser section of the modulator integrated light source module 200 to make a light frequency modulation. Optical booster amplifiers 14 and 34 use a bidirection pumping method for which a pumping light source of 1480 nm wavelength is used. The transmission power and chirping quantities of a modulator are optimized to accomplish the longest regeneration distance of 320 km.

To transmit the supervisory signal, a supervision light source 202 of 1480 nm wavelength range provided in the [[light]] <u>optical</u> booster amplifier is used. The supervisory signal is ~~wavelengthmultiplexed~~ <u>wavelength multiplexed</u> with the main signal before being transmitted [[to a]] downstream. To prevent output of the light booster from decreasing, a WDM (wave division multiplex) coupler 203 for wavelength multiplex of the surveillance and control signal with the main signal is made to also serve as WDM coupler for laser pumping.

A forward pumping optical pre-amplifier <u>15,</u>35 having a pumping source of 1480 nm range accomplishes highly sensitive reception.

On the other hand, to receive the supervisory signal, a WDM coupler 210 for pumping Erbium-doped fiber is used to [[draw]] <u>detect</u> the supervisory signal, which is received by an exclusive receiver. This minimizes degradation of the NF (noise figure). With the use of the light booster amplifiers [[13 and]] <u>14,</u>34 and light pre-amplifiers [[5 and 35]] <u>5,35</u>, the distance between the LT-MUX 1 and the 3R-REP 3 can be made 120 km if they are directly connected together.

The 1R-REP 2 has two Erbium-doped fibers 211 and 216 and pumping light sources of 1480 nm wavelength range used therein. The former laser pumping stage 212 pumps forward, and the latter three laser pumping stages 213, 214, and 215 pump bidirectionally. This accomplishes both lower NF and higher output power. For reception of the supervisory signal by the [[1RREP 2]] <u>1R-REP 2</u>, a WDM coupler 217 for pumping the first Erbium-doped fiber 211 stage is used to [[draw]] <u>detect</u> the supervisory signal [[before]] <u>for</u> an exclusive receiver 218. This minimizes degradation of the NF below 0.2 dB to accomplish

an optimum reception of the supervisory signal.

__Page 33, lines 7-8__: Replace this paragraph with the following amended paragraph:

Fig. 17 is a block diagram for the optical transmission system for [[the]] <u>a</u> ~~short distance~~ <u>short-distance</u> system.

__Page 37, line 1, to page 38, line 4__: Replace the three paragraphs with the following amended paragraphs:

As shown in FIG. 20, the 1R-REP optical transmission system consists of two amplifier stages, including an optical pre-amplifier 301 for magnification with a low noise and an optical booster amplifier 320 for high power magnification. An output of the optical pre-amplifier 301 is connected to an input of the optical booster amplifier 320. This accomplishes a ~~lownoise~~ <u>low noise</u>, high power output characteristic in a wide dynamic range.

Description of the pre-amplifiers is ignored here as it was already made previously by reference to FIG. 16.

The 1R-REP 2 can monitor light outputs and intermediate signal powers and detect opening of the outputs it can control and monitor a gain of each optical amplifier stage. As described previously, the 1R-REP 2 also can receive and transmit the surveillance and control signal of 1.48 .mu.m wavelength. The monitor and control and processing <u>of</u> the surveillance and control signal are made by ~~an surveillance~~ <u>a supervisory</u> signal processor/automatic power control circuit 310.

FIG. 21 is a block diagram for a package construction of the 1R-REP 2. The main signal system of the 1R-REP 2, as shown in the figure, comprises two packages, including a ~~preamplifier~~ <u>pre-amplifier</u> package having the low-noise optical ~~preamplifier~~ <u>pre-amplifier</u> 301 and a booster amplifier package having the high-power optical booster amplifier 320. As will be described later, a single bay having a plurality of shelves, each of which has two systems and the OpS IF as a common section.

__Page 38, lines 14-20__: Replace the paragraph with the following amended paragraph:

The following describes monitor of the 1R repeater section and process of the 1.48 .mu.m surveillance and control signal in detail. It should be noted that the surveillance and control made by the 1R-REP 2 are similarly made by the LT-MUX 1 and the forward

pumping optical ~~preamplifier~~ pre-amplifier 35 and the optical booster amplifier 34 of the 3R-REP 3.

Page 40, lines 5-14: Replace the paragraph with the following amended paragraph:

Number ① in FIG. 20 denotes a surveillance light signal which is taken by a PF-WDM out of the input light having been composed of the main signal light of 1552 nm wavelength and the surveillance and control light signal of 1480 nm wavelength. The surveillance light signal is 3R-processed ~~to convert to~~ and converted to an electrical signal by a supervisory signal receiver. The surveillance light signal is used by the automatic power control circuit surveillance signal processor 310 to detect the supervisory signal input disconnection.

Page 41, lines 8-11: Replace the paragraph with the following amended paragraph:

Number ⑤ in Fig. 20 denotes control signals used by the automatic power control circuit surveillance signal processor 310 [[to]] for stabilization-control at the output of the pumping source and to monitor LD states.

Page 42, line 18 to page 43, line 16: Replace the two paragraphs with the following amended paragraphs:

Still furthermore, the embodiment does not only inform any of the failures of the 1R-REP 2 to the downstream, but also facilitates judgement of a failure point in each of the 1R repeater ~~section~~ sections and also maintains on the inter-office fiber the surveillance and control communication channel between the office having the ~~1RREP 2~~ 1R-REP 2. To do these, the surveillance and control signal light is terminated once for each 1R-REP 2 before being repeated to the downstream through automatic power control circuit surveillance signal processor 310 to transfer. This has the advantage that the surveillance information can be transfered by a single wavelength even if the number of repeaters is increased.

In turn, if the wavelength used for the supervisory signal is out of the range of the optical amplifier, this will not cause saturation in the optical amplifier, and thus will not affect the main signal. For this reason, the light of 1.48 .μm is used as described above. This light provides ~~as little a~~ minimal transmission line fiber loss [[as]] of the main signal waveform, and allows using a WDM (wave division multiplex) coupler to compose and divide the pumping light in common.

Page 44: Replace the first paragraph with the following amended paragraph:

The embodiment accomplishes the feature of remote control in a way [[as that]] shown in FIG. [[22, the]] 22.. The surveillance and control signal used is of a 48 byte-long frame for period of 1 msec at a rate of 384 kb/sec, and the DCC of 192 kb/sec is maintained within the surveillance and control signal. The frame has 1 byte for information of severe failures every period of 1 msec. This accomplishes the feature equivalent to the F1 byte of the SDH.

Page 46: Replace the first two paragraphs with the following amended paragraphs:

FIG. 23 is for the inter-office transmission line of the LT-MUX 1. FIG. 24 is for the intra-office transmission line of the [[LTMUX 1]] LT-MUX 1. The LT-MUX 1, as shown in the figures, comprises a high-speed IF shelf 600, a low-speed IF shelf 700, a supervisory control/OpS 650, an OH IF 660, and a clock section 670.

The high-speed IF shelf 600 comprises an OPTAMP S 601 having features as the optical booster amplifier 14 of the transmitting system, an OPTAMP R 603 having features as the optical ~~preamplifier~~ pre-amplifier 15 of the receiving system, a 10G IF S 602, a 10G IF [[S]] R 604, and a plurality of SOH 605 boards. The ~~lowspeed~~ low-speed IF shelf 700 comprises a plurality of SELs 701, and a plurality of intra-office IF 702 packages. The high-speed IF shelf 600 and the low-speed IF shelf 700 are connected together by an intra-equipment interface of 155 Mb/sec rate.

Page 50, line 4 to Page 51, line 19: Replace the five paragraphs with the following amended paragraphs:

The transmitter of the LT-MUX 1 forming the short distance system, as described in the figure, has no OPTAMP [[S 603]] S 601. The 10G IF S 602, unlike that of the long distance system, uses a semiconductor optical amplifier of preferably smaller size and lower power consumption for optical amplification in the 80-km transmission. The semiconductor optical amplifier can be made to occupy as narrow an area as the modulator with LD, and can be implemented in the 10G IF S 602 shelf. The embodiment, as shown in the figure, uses a modulator of an electric field absorption type for the external modulator. The electric field absorption type modulator is integrated to a module of small size as electric field absorption type ~~device~~ devices are structurally practical to integrate with the laser diode for the light

source.

FIG. 28 is a block diagram for the receiver of the LT-MUX 1 forming the ~~long-distance~~ long-distance system.

The receiver comprises the OPTAMP R 603 which is an optical amplifier and the 10G O/E 611 having an opto-electric converter 693 and a high-speed demultiplex circuit 692. The OPTAMP R 630, as shown in the figure, is made up of an optical fiber amplifier having an optical pre-amplifier feature, and is separately implemented in its respective board. The opto-electric converter 693 is made up of a front module, an amplifier, a timing extractor, and a discriminator circuit. The ~~highspeed~~ high-speed demultiplex circuit 692 converts the 9.95 Gb/sec signal to 622 Mb/sec in a way of parallel demultiplex. Description of the reception operation is ignored as it was already made by reference to FIG. 16.

FIG. 29 is a block diagram for the receiver of the LT-MUX 1 forming the short distance system.

The short distance short-distance system is different from the ~~long-distance~~ long-distance system in that the ~~short-distance~~ short-distance system has no OPTAMP R 603 and uses an APD 694 for opto-electric conversion. As the APD 694 is capable of more sensitive reception than Pln-PD, the ~~short-distance~~ short-distance system needs no optical amplifier, thus resulting in a smaller system.

Page 53: Replace the entire page with the following amended page:

As described above, the embodiment can appropriately combine the high-speed IF shelves 600, the low-speed IF shelves 700, and the 40G switch shelves 900 in the building block way. This allows accomplishment of a desired equipment with use of the common shelves in a ~~minimized~~ minimal construction. Also, the embodiment allows accomplishment of the 3R-REP 3 by combination of the boards of the high-speed IF shelf 600 as will be described later.

The following describes the surveillance and control system for the LT-MUX 1.

FIG. 31 is a block diagram for extracted parts serving [[to]] as the surveillance and control system for the LT-MUX 1.

FIG. 32 lists features of the functional blocks.

[[Figs.]] Tables 13, 14, 15, and 16 chart features of the surveillance and control system.

In FIGS. 31 and 32, the SVCONT 703 is installed for each low-speed IF shelf. The

SEMF 651, the OpS IF 652, and RuT IF 653 are equipped in the common a shelf as will be described later.

<u>Page 61, line 25 to page 62, line 16</u>: Replace the two paragraphs with the following amended paragraphs:

The VC buffer is a kind of AU pointer converting circuit. At the time of output, a new AU pointer value is calculated before being inserted into the AU. The calculation principles are the same as those of the usual pointer converting circuit. As the adjustable transmission delay difference is 4 km, the process cannot only be applied <u>can be applied not only</u> to the intra-office transmission line, but also to a short or intermediate inter-office transmission line. Thus, in the SEL, the hitless switching process feature section is constructed so that it can[[not]] be used <u>not only</u> for switching the intra-office interface, but also for switching the 10 Gb/sec transmission line interface.

7. Description of 3R-REP

FIG. 36 is a block diagram for a construction of the 3R-REP 3. Table 18 lists features of functional blocks of the 3R-REP 3.

<u>Page 64, line 17 to page 67, line 19</u>: Replace with the following amended paragraphs:

A rack of the embodiment, as shown in the figure, has three shelves each of which contains two 1R-REP 2 systems, or six [[1RREP2]] <u>1R-REP 3</u> systems in total. Each system. comprises two subsystems: the repeaters 301 and [[302]] <u>320</u>. For an unattended office which needs remote monitor and control, these are implemented in the same shelf as the system to which the OpS IF 651 and the like serve. Note that a power source board 810 is for the optical pre-amplifier 301 and the optical booster amplifier 320.

FIG. 38 [[is]] <u>shows</u> structures of the optical ~~preamplifier~~ <u>pre-amplifier</u> 301 and optical booster amplifier 320 forming a single 1R-REP 2 system. The optical ~~preamplifier~~ <u>pre-amplifier</u> 301 and the optical booster amplifier 320, as shown in FIG. 37, occupy two-fold and four-fold widths in reference to a standard board width respectively, or six-fold width in total. They are naturally air-cooled. Note that a TEC drive circuit in FIG. 38 is a circuit added to the pumping light source to control a temperature adjustment for thermoelectron cooling devices.

Implementation of the LT-MUX 1 is described below.

FIG. 39 is a frontview for an implementation of the LT-MUX 1.

The construction shown is for accomplishing the transmission line 1+1 redundancy system switching. The functional boards of the high-speed IF unit 600 and the low-speed IF unit 700, as shown in the figure, are all doubled as in a working system 0 and a waiting system 1. FIG. 40 is a front view for an implementation of two systems of the LT-MUX 1 in a single rack without the redundancy configuration.

The 10G IF R 604 package and the 10G IF S 602 board, as shown in the figure, are of two-fold [[wide]] width as these have many components. Similarly, the OPTAMP R 603 board and the OPTAMP S 601 board are of two-fold [[wide]] width.

FIG. 41 is a front view for an implementation of the LT-MUX 1 for constructing the small scale switching node 120 with the 40G switch unit built in as shown in FIG. 6b.

In this case, as shown in the figure, are implemented two highspeed interface units 600, a duplexed 40G switch unit 900, and a duplexed low-speed IF unit 700. The 40G switch unit 900, as shown in FIG. 42, is three-dimensionally constructed in view of the flow of its signals. That is, a plurality of boards MUX/DMUX containing a plurality of multiplex/ demultiplex circuits 901 and 902 and a time-division switch (TSW) 903, are three-dimensionally connected together with use of a subpanel for a time switch unit. This construction can be made small.

Implementing the 40G switch into the shelf is made in a way that the TSW 903 is put in front, the 40G switch unit 900 is put into the shelf, and the MUX/DMUX board 901/902 is connected with other units on the rear side of the shelf.

FIG. 43a is a front view for an implementation of the LT-MUX 1 for constructing the large scale switching node 110 with a multi-stage switch meshed network of a plurality of the 40G switch units built therein.

In this case, as shown in the figure, a plurality of racks have the 40G switch units, the high-speed IF units 600, and the lowspeed IF units 700 built therein the high-speed IF units 600, and the low-speed IF units 700 can be connected with the switch multi-stage network.

Finally, FIG. 44 is a front view for an implementation of the [[3RREP 3]] 3R-REP 3.

As shown in the figure, a single rack has four shelves each of which contains a main signal board, including OPTAMP R 603, 10G IF R 604, 10G IF S 602, and OPTAMP S 601 packages, and a common section, such as an OpS IF 651. This construction allows a single shelf to complete all the features of a single equipment. It is possible to easily increase or remove the equipment in shelf units as needed.

As described so far, the present invention can flexibly build up the optical transmission system depending on capacities and functions required.